

The effect of dietary protein degradability on production characteristics of lactating Saanen does

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Abstract

Twenty-one lactating Saanen goats of similar milk yield and lactation number were fed one of three experimental protein diets: low UDP (160 g CP/kg DM), high UDP, low protein (128 g CP/kg DM), and high UDP high protein (160 g CP/kg DM). The aim of the study was to determine whether an increased UDP and decreased RDP content would increase production and also whether a decreased CP content and an increased UDP content would sustain the production of lactating Saanen does. The does on the low UDP diet had significantly higher feed intakes and were significantly heavier at the end of the trial period of 120 days. No differences in milk production or composition were observed. The CP intake/kg milk yield was 113 ± 0.01 g (4% butterfat). The low protein (20% less CP) high UDP diet was able to sustain a similar milk production with a significantly better conversion (29.3%) of N into milk protein than the other diets. In contrast the decrease in RDP and increase in UDP content, at the same CP level, did not improve the production potential of the does.

Keywords: Dairy goats, Saanen, protein degradability, milk production

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Introduction

During the past 20 years the dairy goat population across the globe has increased by 52% (Haenlein, 2000). Knowledge of the protein requirements and particularly protein degradability requirements of dairy goats is scarce. In recent years there has, however, been an increased interest in the effect of protein supplementation on lactating animals (Mishra & Rai, 1996). Santos *et al.* (1998) reviewed 108 published studies from 1985 till 1995. It was strongly suggested that the use of rumen undegradable protein (UDP) in the diets of dairy cows often resulted in a decreased rumen degradable protein (RDP) intake, and a change in absorbed amino acid profiles. The review concluded that increased UDP levels in the diet do not consistently improve lactation production. The aim of the present study was to determine whether an increased UDP and decreased RDP content would increase production and also whether a decreased crude protein (CP) content and an increased UDP content would sustain the production of lactating Saanen does.

Materials and Methods

Twenty-four lactating Saanen does (59.0 ± 2.6 kg live weight) were divided according to milk production and lactation number into three groups of eight each. Each group was allocated to one of the experimental protein diets: low UDP, low protein-high UDP and high UDP on an *ad libitum* feeding regimen. The RDP:UDP ratios in the pelleted diets were 72:28, 62:38 and 55:45, respectively. The low UDP and high UDP diets were iso-nitrogenous, at 160 g CP/kg DM, whereas the low protein-high UDP diet contained 20% less CP (128 g CP/kg DM). All the diets were iso-energetic. Local fish meal and cotton oilcake were used as natural sources of UDP.

The experiment was carried out over a 120 day lactation period, starting at 14 days *post partum*. The does were milked twice daily at 6:30 and 15:30. Milk production was recorded after each milking. The body weight, feed intake and milk samples for analyses were taken on a weekly basis. During the second last week of the production trial, six does/diet were used to compare the three diets in a nitrogen metabolism trial. Total collection of faeces and urine was conducted daily. Twenty millilitre of urine preservative (80 g potassium dichromate and 20 g mercuric chloride dissolved in 1 L of distilled water) were added each morning to the urine collection jugs to prevent volatilisation of ammonia from the urine. Faeces and urine

were sub-sampled daily (10%) and composited over the whole period, prior to chemical analysis. Nitrogen (N) retention was corrected both for endogenous urinary N and metabolic faecal N according to McDonald *et al.* (1988). Methane gas production (MJ/day) was calculated as 8% of energy intake (McDonald *et al.*, 1988).

Milk samples were analysed with a Milk-O-Scan apparatus for butterfat, protein, lactose and urea. The N and gross energy content of the feed, faeces and urine were determined according to the AOAC (1995). During the third week of the trial three does of different treatments became ill with bluetongue and refused all feed for a couple of days. Therefore, the data from these does were omitted. Data were tested for normality using the Shapiro-Wilk statistic (Shapiro & Wilk, 1965). Data were analysed as a randomised block, using the GLM procedure of SAS (1994).

Results and Discussion

From Table 1 it is evident that both feed and dry matter intake were higher ($P < 0.05$) in the low UDP group than in the other treatments. Neither milk production, nor milk composition differed between treatments. Only the CP intake showed a significant difference between diets for all the milk production efficiency characteristics calculated.

Table 1 The effect of dietary RDP:UDP ratio and crude protein concentration on the milk production parameters and efficiency (mean \pm s.e.) in lactating Saanen does over a 120-day trial period

	Low UDP	Low protein, high UDP	High UDP
Number of animals	8	6	7
Initial bodyweight (kg)	61 \pm 2.4	55 \pm 2.6	61 \pm 2.8
Final bodyweight (kg)	65 ^a \pm 2.1	56 ^b \pm 2.3	58.6 ^{ab} \pm 2.8
Feed intake (kg)	2.1 ^a \pm 0.11	1.7 ^b \pm 0.11	1.7 ^b \pm 0.12
Dry matter intake (kg/day)	1.9 ^a \pm 0.01	1.5 ^b \pm 0.10	1.6 ^b \pm 0.11
Milk production (kg/day)	1. 3.0 \pm 0.25	1. 2.6 \pm 0.29	12.8 \pm 0.34
Fat corrected milk, 4% (kg/day)	2.8 \pm 0.06	2.5 \pm 0.26	2.4 \pm 0.31
Milk protein (%)	2.7 \pm 0.06	2.7 \pm 0.07	2.7 \pm 0.08
Milk lactose (%)	4.5 \pm 0.06	4.6 \pm 0.07	4.6 \pm 0.08
Corrected fat (%)	2.3 \pm 0.13	2.7 \pm 0.15	2.3 \pm 0.18
Total fat for 120 days (kg)	9.4 \pm 0.74	8.2 \pm 0.84	8.7 \pm 0.10
Total protein for 120 days (kg)	13.1 \pm 1.09	12.1 \pm 1.24	11.2 \pm 1.46
Urea (mg/dl)	34.5 \pm 1.65	31.5 \pm 1.87	34.8 \pm 2.21
Milk yield per kg dry matter intake (kg)	1.6 \pm 0.10	1.7 \pm 0.11	1.8 \pm 0.12
Fat corrected milk (4 %) per kg dry matter intake (kg)	1.5 \pm 0.11	1.7 \pm 0.12	1.6 \pm 0.13
ME intake (MJ/day)	18.1 \pm 0.96	15.7 \pm 1.03	16.0 \pm 1.11
ME intake per kg milk yield (MJ)	6.1 \pm 0.43	6.5 \pm 0.45	5.8 \pm 0.49
CP intake (g/day)	350 ^a \pm 0.02	260 ^b \pm 0.02	300 ^b \pm 0.02
CP intake per kg milk yield (g)	120 \pm 0.01	110 \pm 0.01	110 \pm 0.01

^{a, b}Values in rows bearing different superscript letters differ significantly at $P < 0.05$

According to Van der Merwe & Smith (1991) a 50 kg doe requires 150 g of CP for the production of 1 kg of milk. This differs considerably from the value for goats stated in the NRC (1981), where the total protein requirement for the production of 1 L milk with a 3% butterfat is given as 64 g. In the present study the CP intake per kg milk yield was 113 \pm 0.01 g (4% butterfat). This value was similar to that recorded by Mishra & Rai (1996) for lactating goats.

According to Table 2 the does on the low UDP diet had a significantly higher intake of N than the low protein high UDP diet, due to their higher feed intake and higher dietary CP level. Regarding N loss through the faeces and urine, the same differences ($P < 0.05$) as in N intake were observed. No significant differences in N loss through milk production were observed. The total loss of N was higher ($P < 0.05$) in the low UDP diet compared with the low protein high UDP diet. Nitrogen secretion in milk as a percentage of the total N intake was significantly higher in the low protein high UDP diet compared with the low UDP diet.

Table 2 The effect of dietary RDP:UDP ratio and crude protein concentration on nitrogen balance (mean) in lactating Saanen does over a 120-day trial period (n = 6)

	Low UDP	Low protein, high UDP	High UDP	s.e.m.
Nitrogen _{in} (g/day)	57.2 ^a	44.2 ^b	51.1 ^{ab}	3.42
Nitrogen _{faeces} (g/day)	15.1 ^a	10.7 ^b	11.5 ^{ab}	1.22
Nitrogen _{urine} (g/day)	23.4 ^a	11.7 ^b	17.8 ^{ab}	2.88
Nitrogen _{milk} (g/day)	12.8	13.1	13.1	1.41
Nitrogen _{out total} (g/day)	51.4 ^a	35.4 ^b	42.4 ^{ab}	4.38
Nitrogen _{retention} (% of total nitrogen)	16.4	19.7	20.9	3.57
Nitrogen _{secretion in the milk} (% of total nitrogen)	22.4 ^b	29.3 ^a	25.6 ^{ab}	1.94

^{a, b}Values in rows bearing different superscript letters differ significantly at P < 0.05

Conclusions

Different RDP:UDP ratios in the diets increased the DM intake in the low UDP diet. This did not influence the milk production or composition between diets. However, the low protein (20% less CP) high UDP diet was able to sustain similar milk production with a significantly better conversion (29.3%) of N into milk protein than the other diets.

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